uUALITY ASSURANCE AND
COMPLIANCE DEPT.
QA TECH D JOHNSON

MICROWAVE RADIO COMM.

TECHNICAL CONSTRUCTION FILE FOR

CODE RUNNER 2 -ANALOG /DIGITAL MICROWAVE VIDEO TRANSPORT SYSTEMS

APLLICATION CONSISTS OF ANALOG/ DIGITAL TRANSMISSIONS FOR ENG MOBILE BROADCASTS

The objective of this TCF is to demonstrate the conformance of Microwave Radio Communications Inc. CODERUNNER 2® video transport system to the essential requirements of 47CFR 90 and 47CFR Pt. 74 Subpart F and FCC-04-265A1.

Note that this document contains test data and operational limits that are not specifically required or detailed by the governing compliance limits, they are included to show Microwave Radio Communications Inc. due diligence in the production of a quality product and verification of compliance and public safety.

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Table of contents

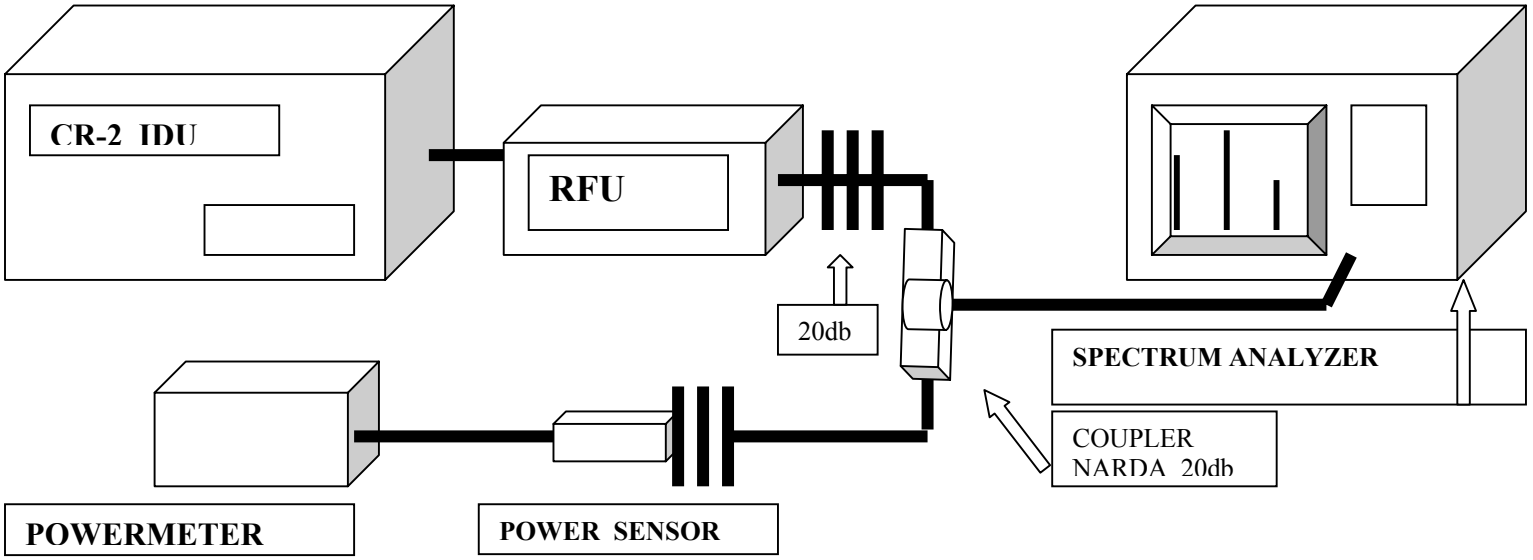
Test equipment

All spectral measurements made on a HP 8563E spectrum analyzer

All power measurement made using a HP 437B power meter and matched power sensor

A 20 db narda 50 watt attenuator and coaxial coupler with 20 db of loss between the output of the transmitter and the spectrum analyzer

All frequency measurements made using a HP 5343A microwave frequency counter



The Code runner-2-transmitter was designed to be both an analog and digital transmitter for portable/mobile ENG applications.

The Code runner 2 is an integrated flexible solution consisting of

1. **A rack mounted indoor unit [IDU], typically mounted inside an ENG vehicle.**

2. **A mast mounted outdoor unit [ODU] also called the RF unit or {RFU}**

3. **Power options: The code runner 2 may be operated from the 115 to 220 volt AC mains, or from the 18 to 36 volts DC vehicle power. Power is supplied to the IDU which in turn provides power to the ODU via the triax or N type cable between them**

4. **The IDU's modular design allows for both analog and digital operation in the digital mode the COFDM modulation can be set for QPSK, 16QAM or 64 QAM or the transmitter may be operated as a full featured analog transmitter.**

5. **Several band and frequency options are available. The code runner can be ordered as a single band unit or in a dual band configuration, 2to 3 GHz, 6 to 7GHz and or 12 to 13 GHz (for the purpose of this document and submittal this document is referencing 1999MHZ to 2700MHZ.**

6. **The code runner 2 system has many other options that are not to be detailed in this document for further information see the operations manual or other product related literature.**

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System components:

The MRC Code runner system is made of the following componenents.

- **A rack mounted indoor unit { IDU } The IDU houses the base band circuitry, power supply and control modules. It will accept a variety of video inputs analog, digital and audio as well as providing a 70Mhz IF output at 0dbm**
- **The {ODU } contains the up-converters and power amplifiers and a band pass filter**
- **The two components are connected by a nycoil conduit with either a triax or N type connection for power and intermodule communication. With a max power output of 41 dbm @ 14 watts**

IDU

Figure 2-3: Front Panel Controls

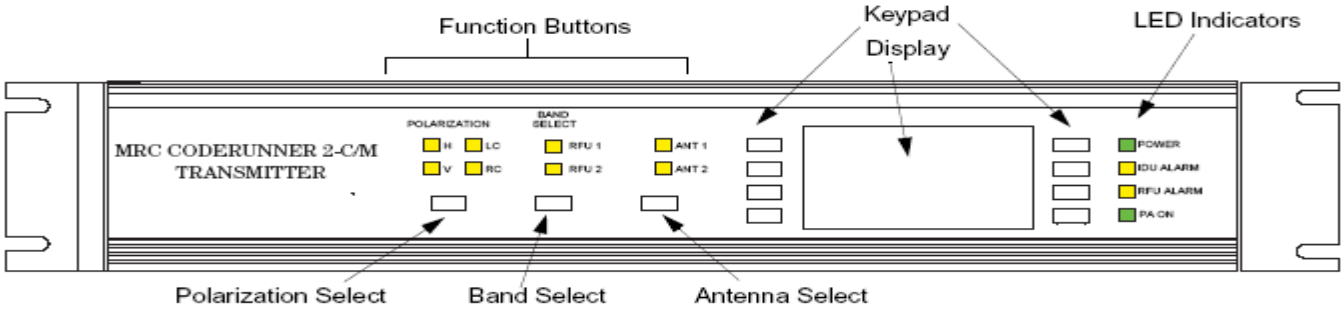
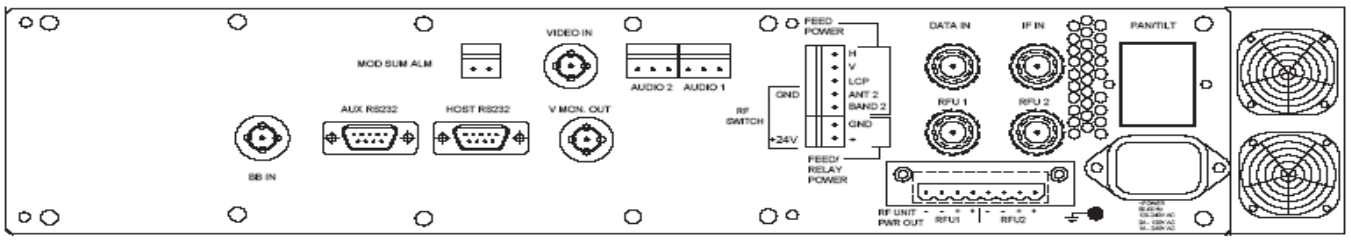


Figure 2-4: Rear Panel Connectors



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ODU

Figure 5-12: Attaching ODU(s) to Mounting Plate

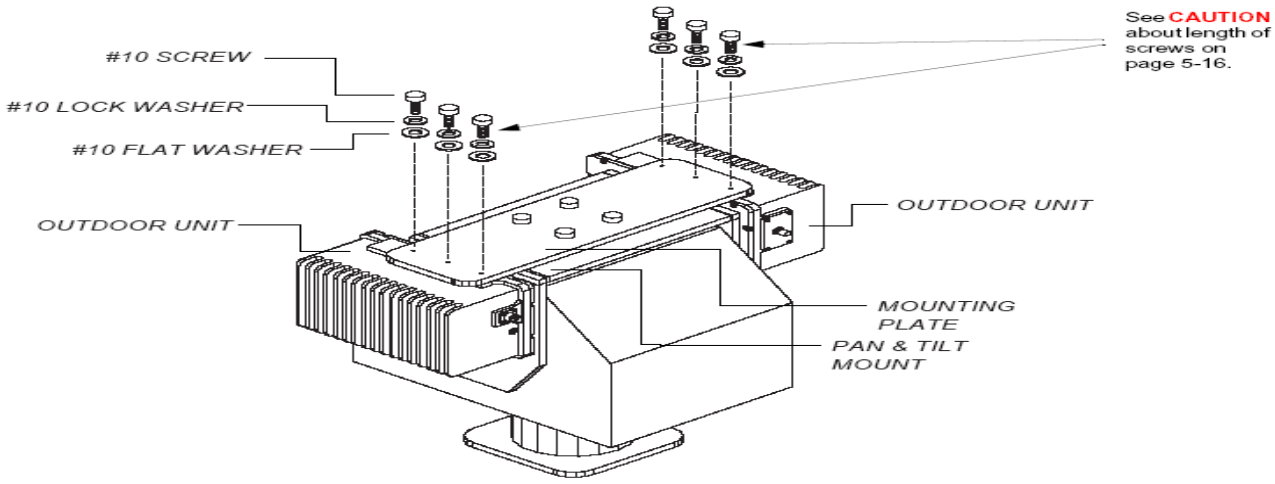

Figure 2-5: Single Band Operation with 2 Antennas

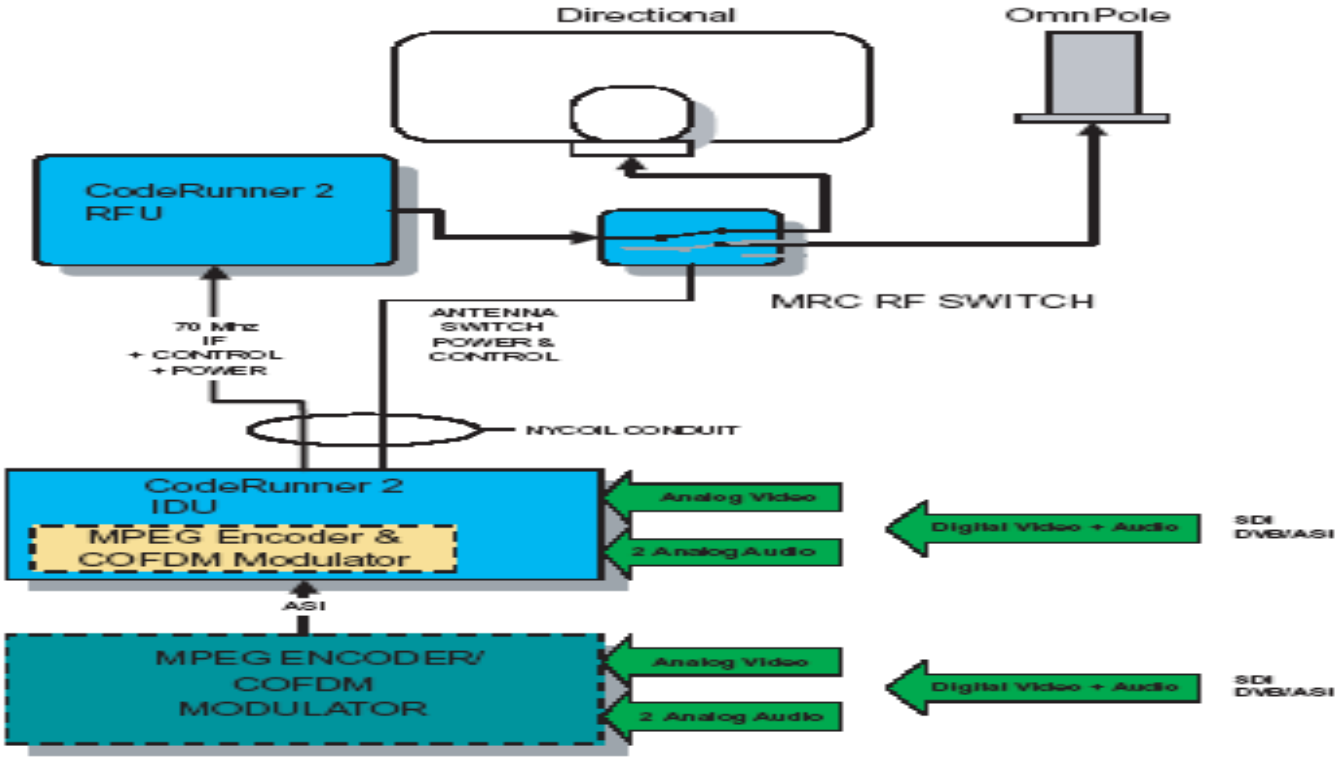

Figure 2-5: Single Band Operation with 2 Antennas

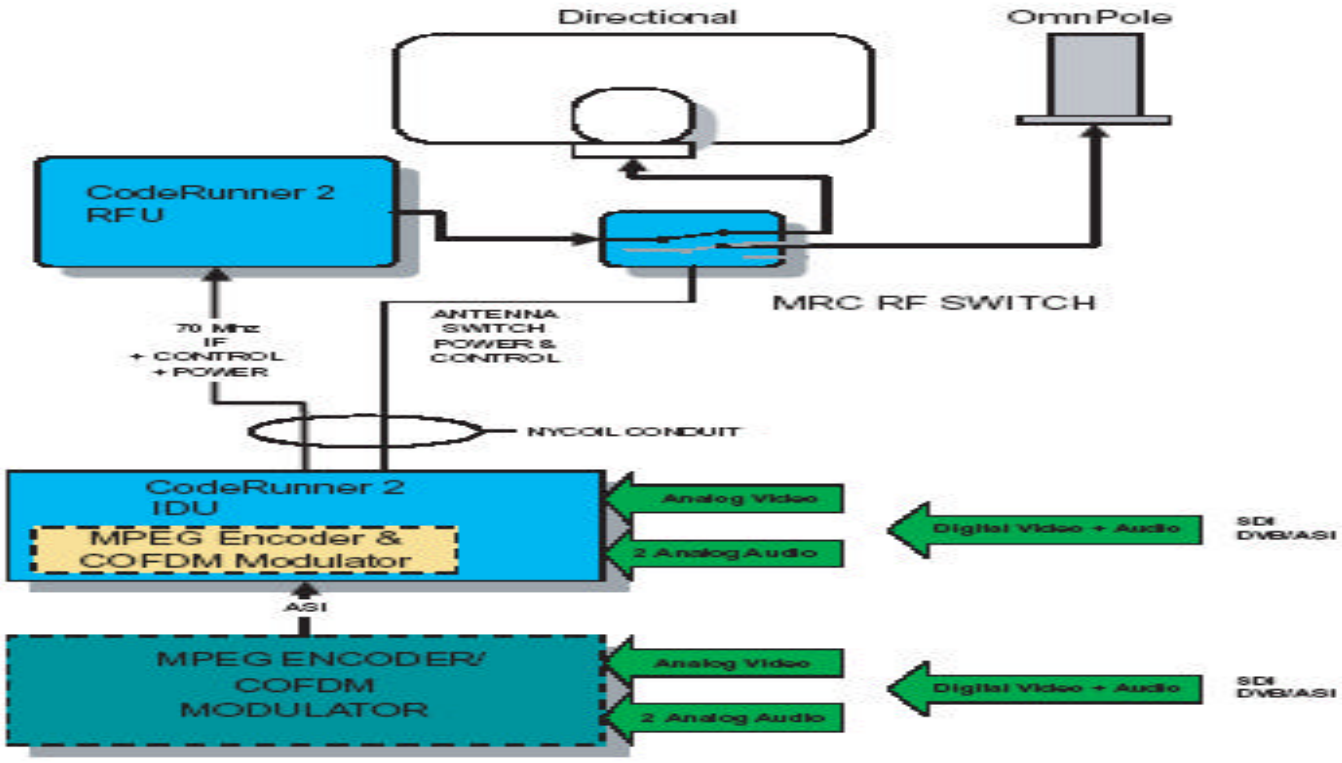

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Figure 5-13: Typical installation with RF Switch and Triax

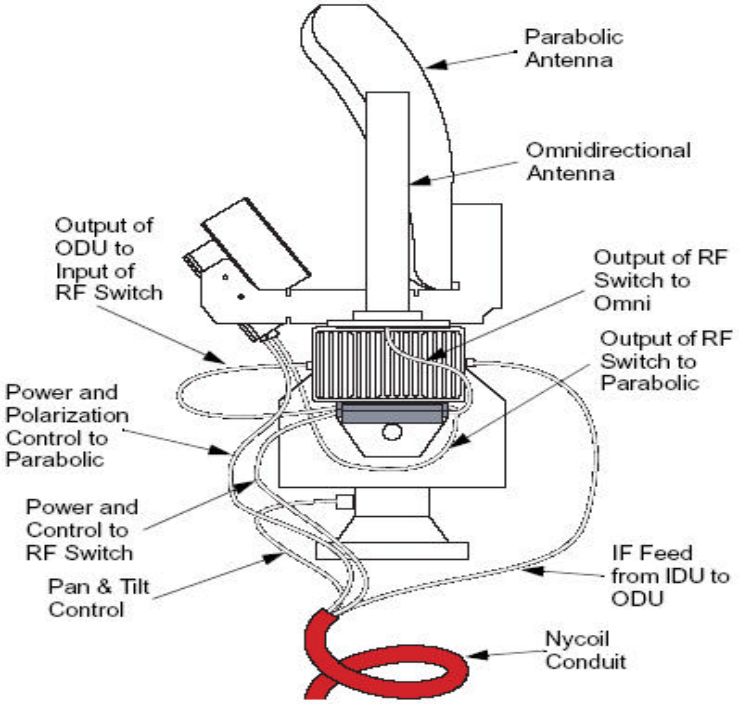


Figure 5-14: Typical Installation with Parabolic and Triax

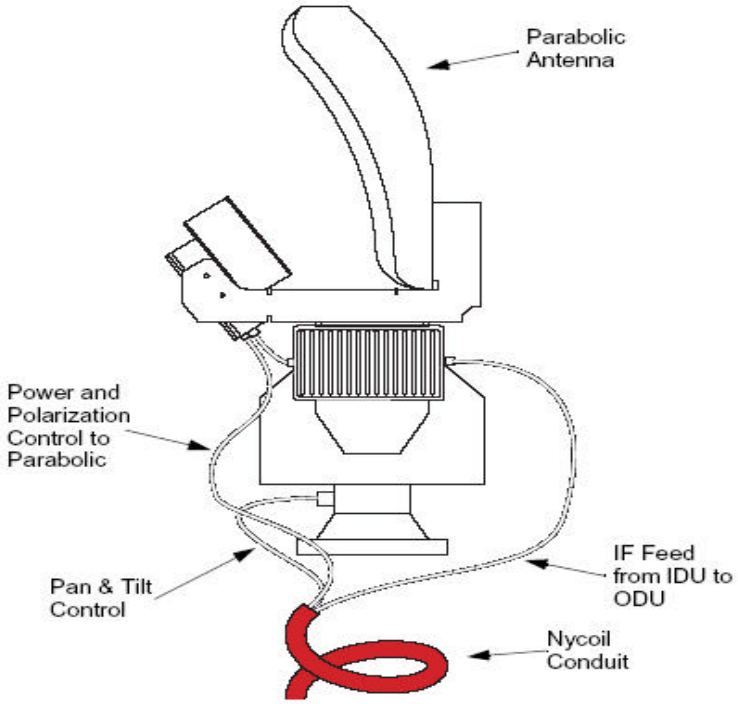
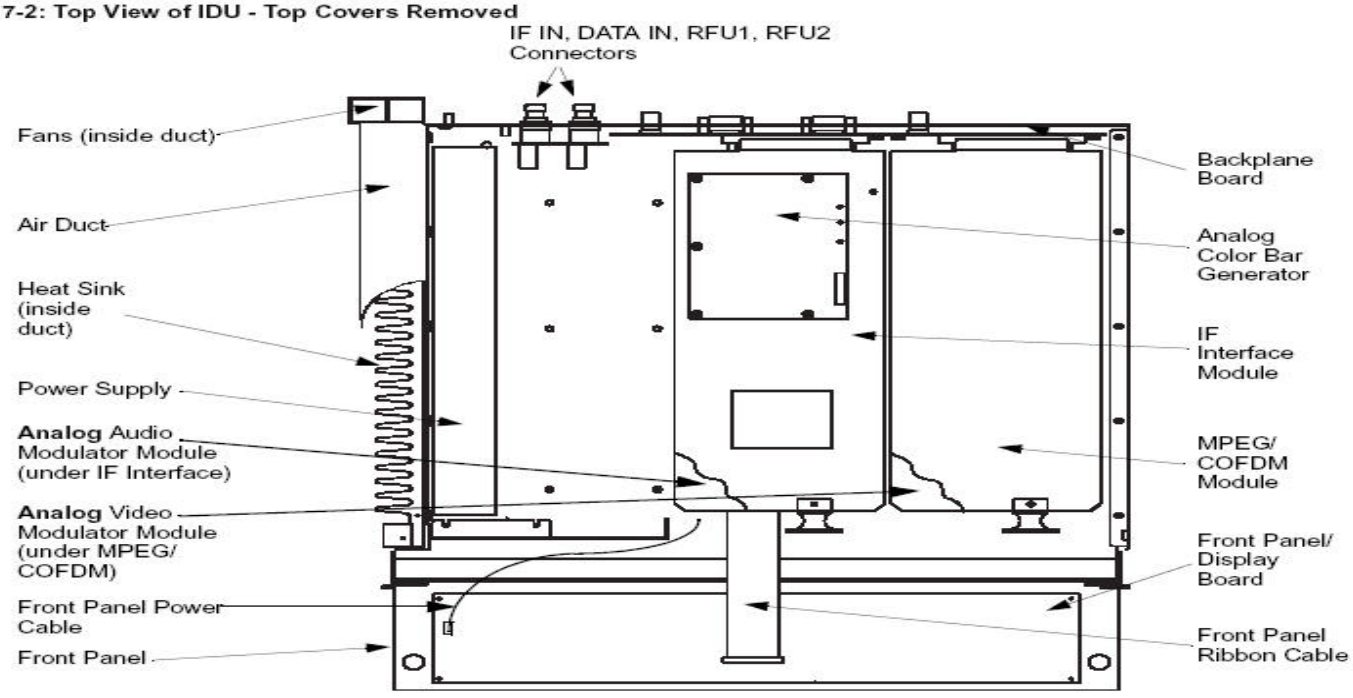
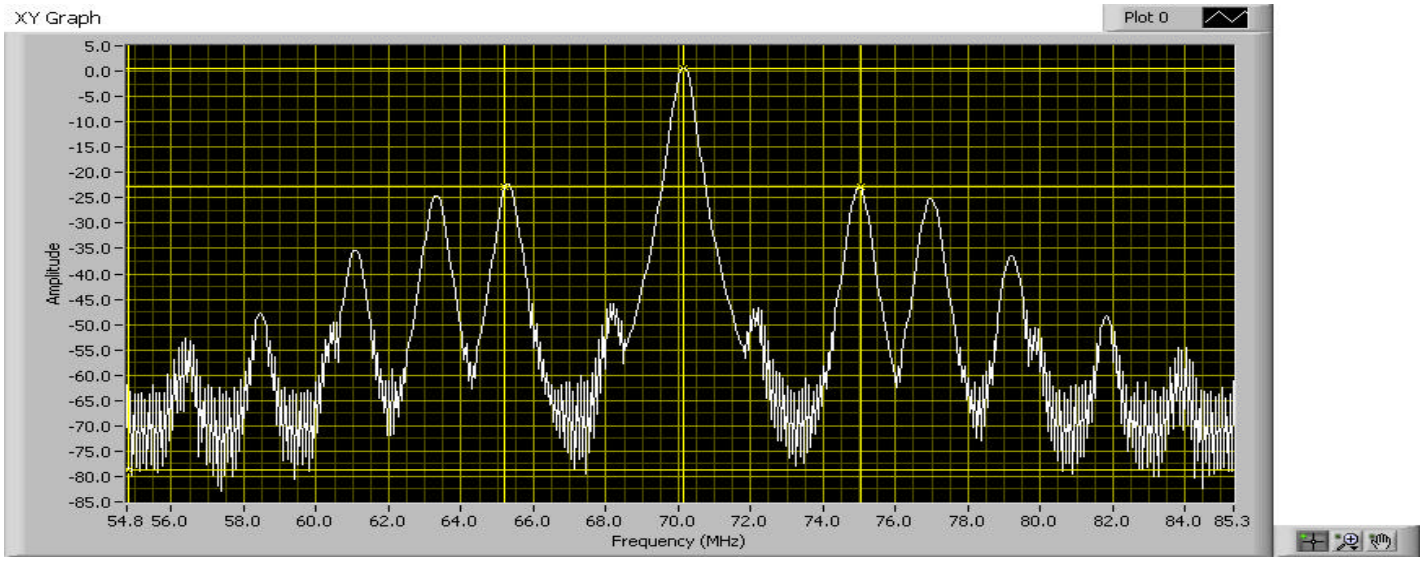


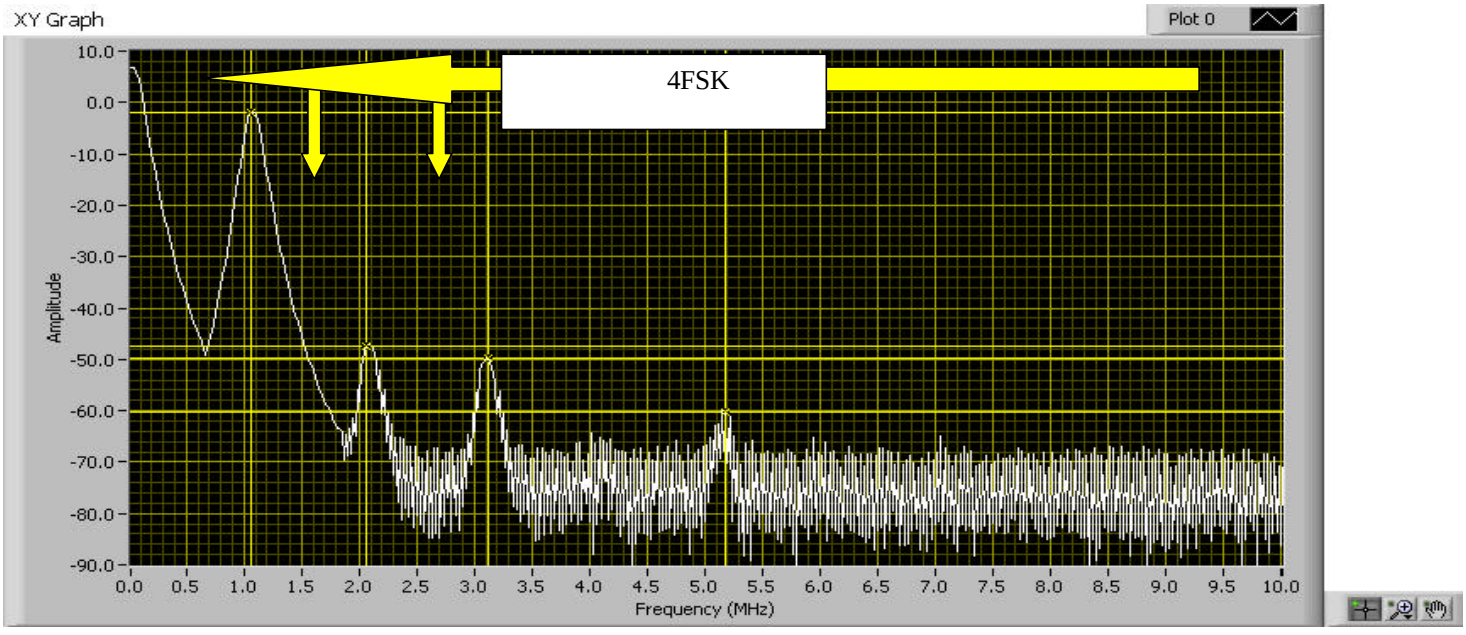
Figure 7-2: Top View of IDU - Top Covers Removed



Spurious response of 70MHz IF output of IDU



0Hz to 10MHz spurious response (IDU)



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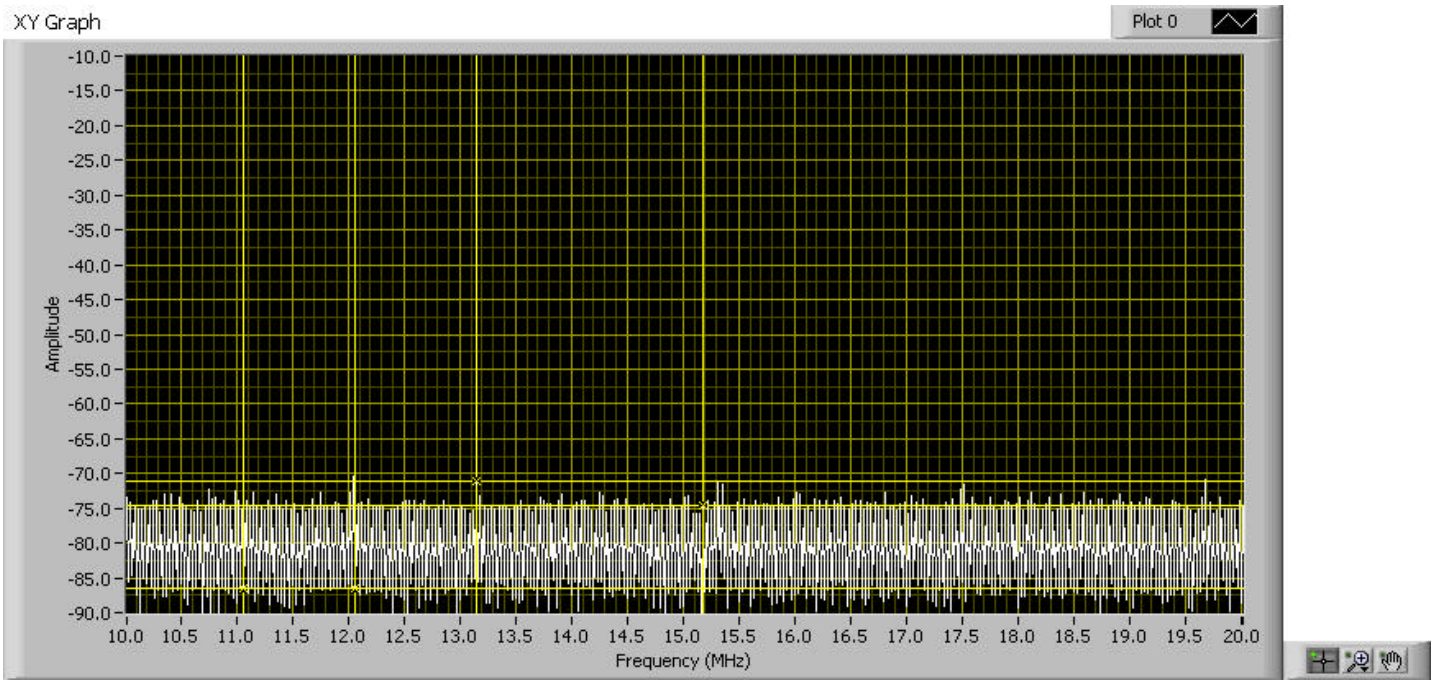
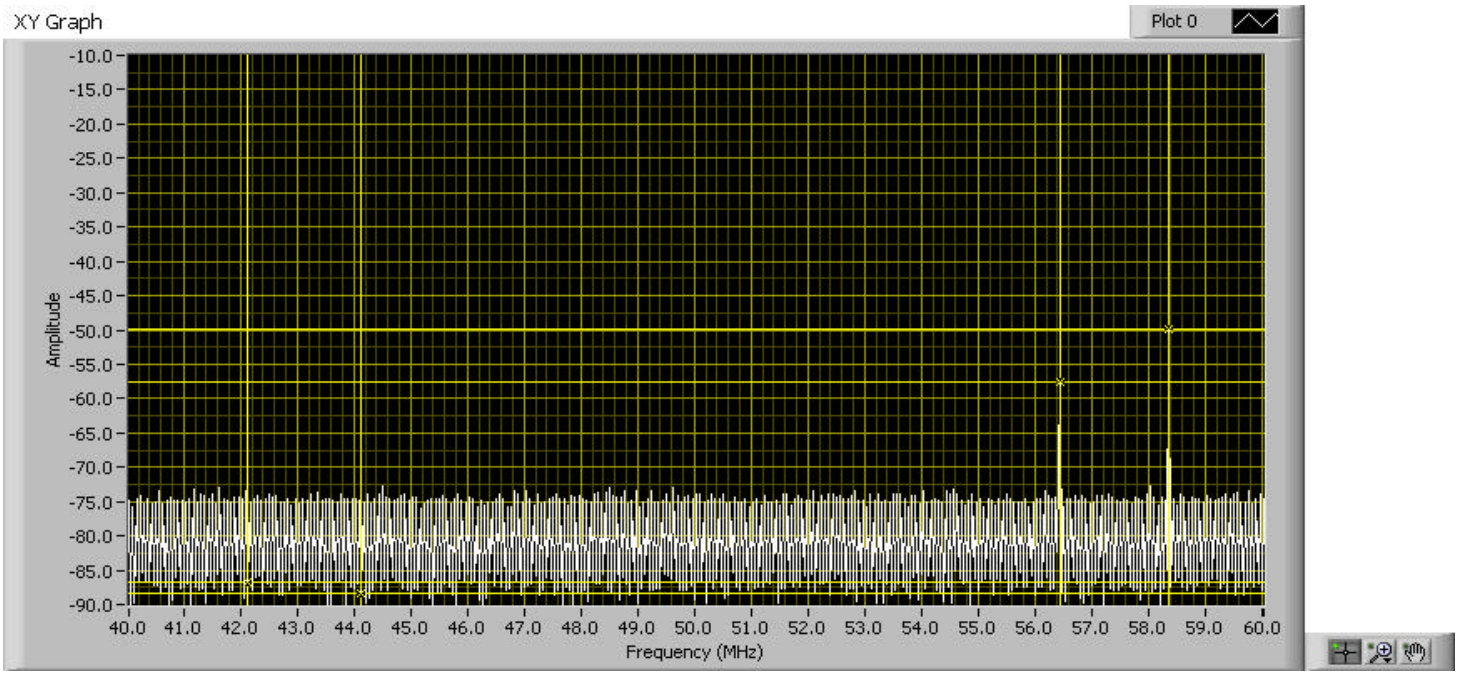
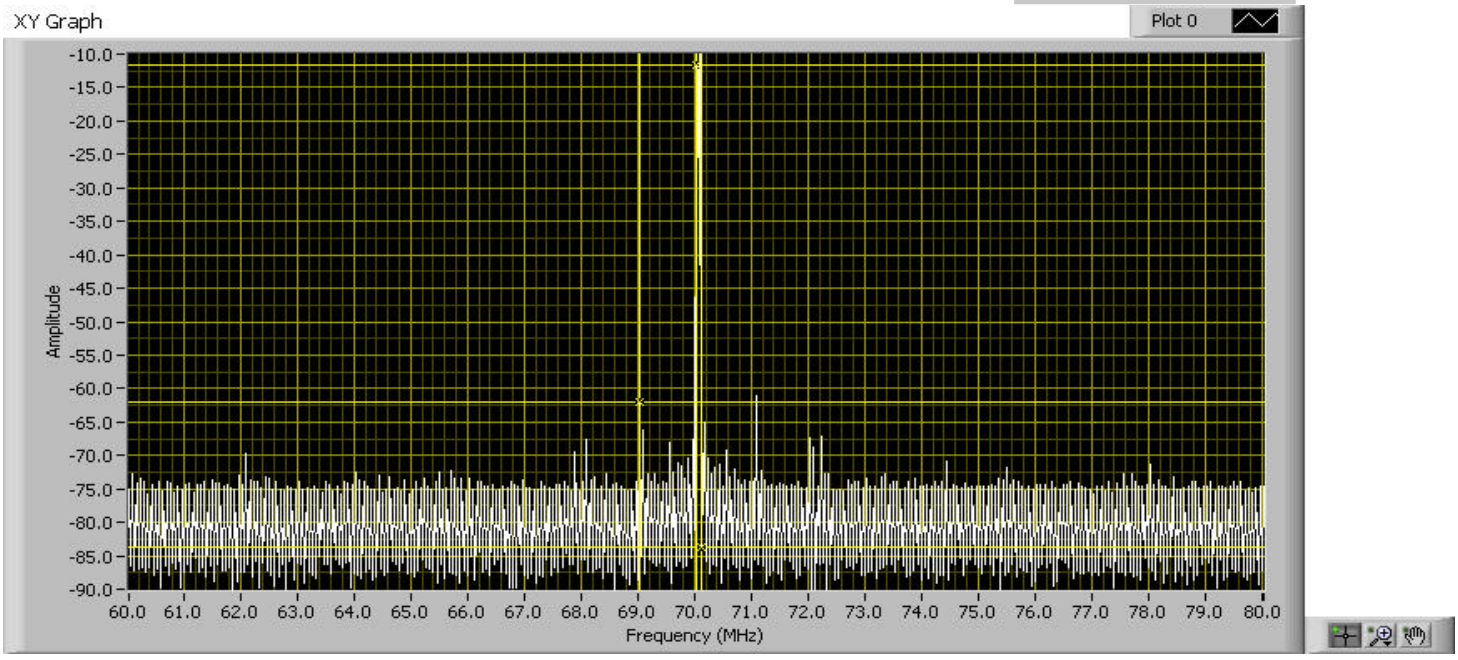
10 TO 20 MHz



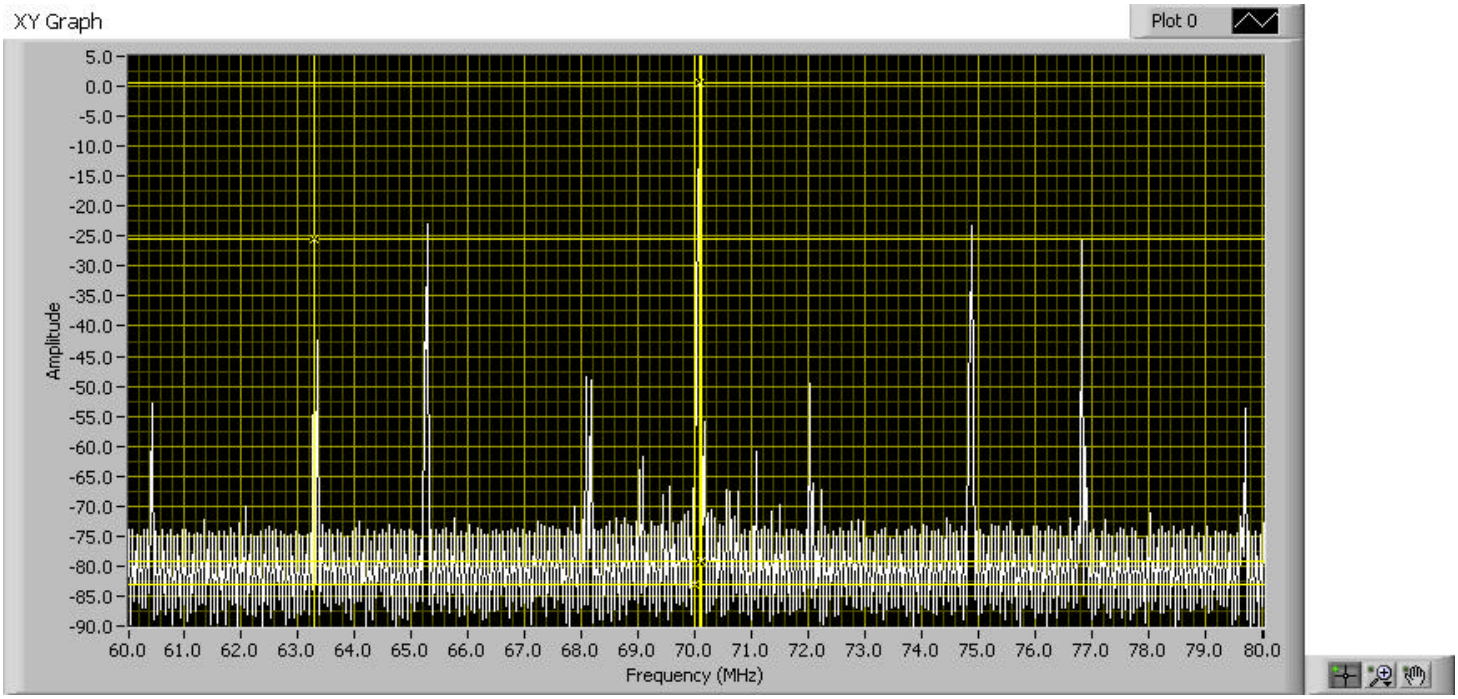
40 TO 60



60 TO 80 MHz AUDIO CARRIERS OFF



60TO 80 AUDIO CARRIERS ON



80 TO 100MHz AUDIOS ON

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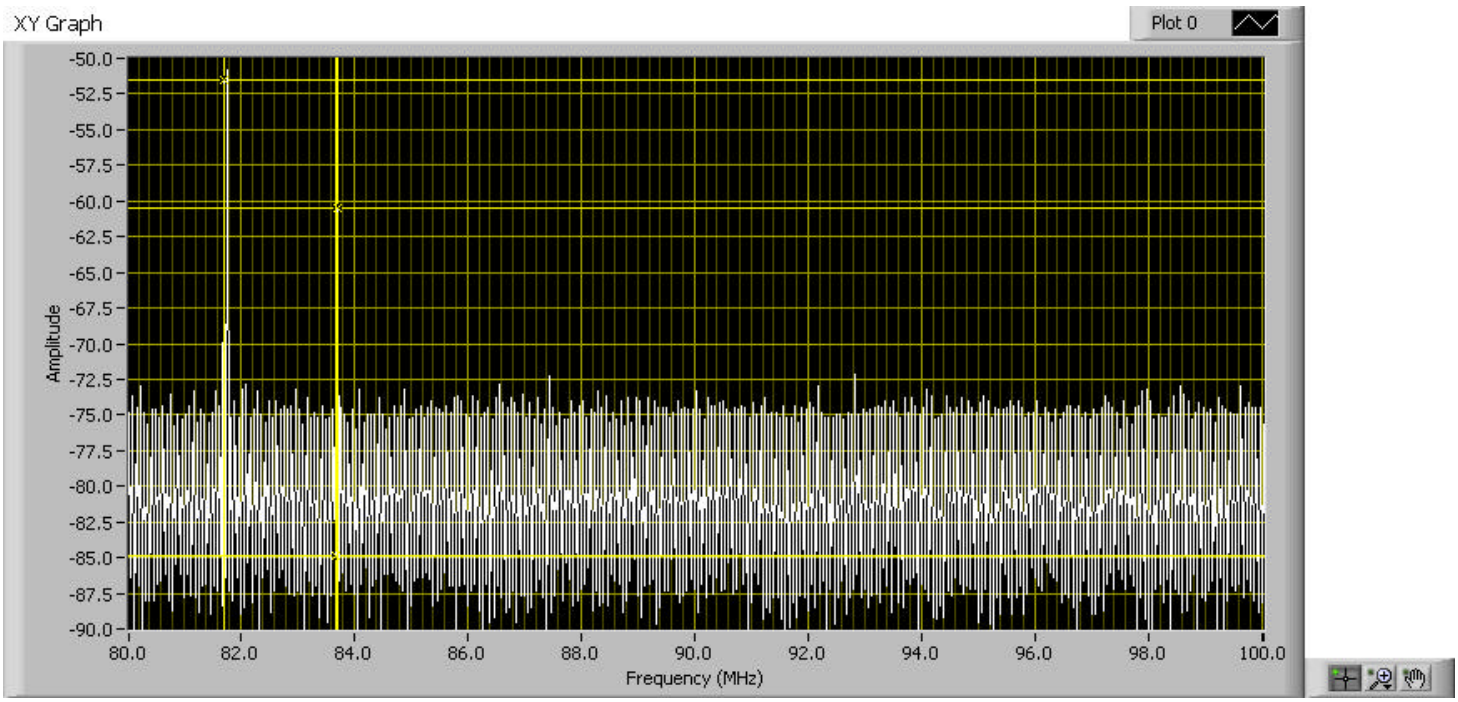
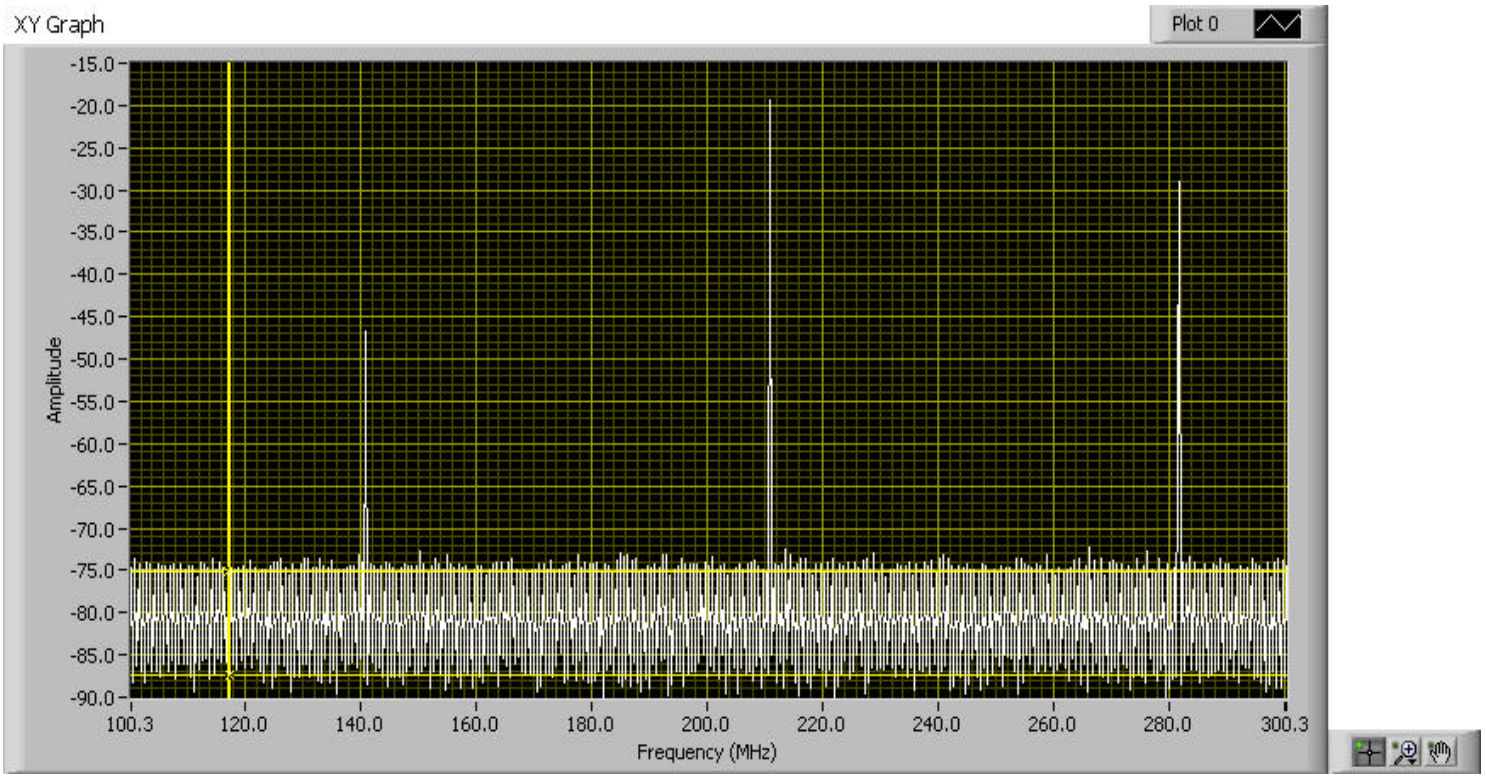
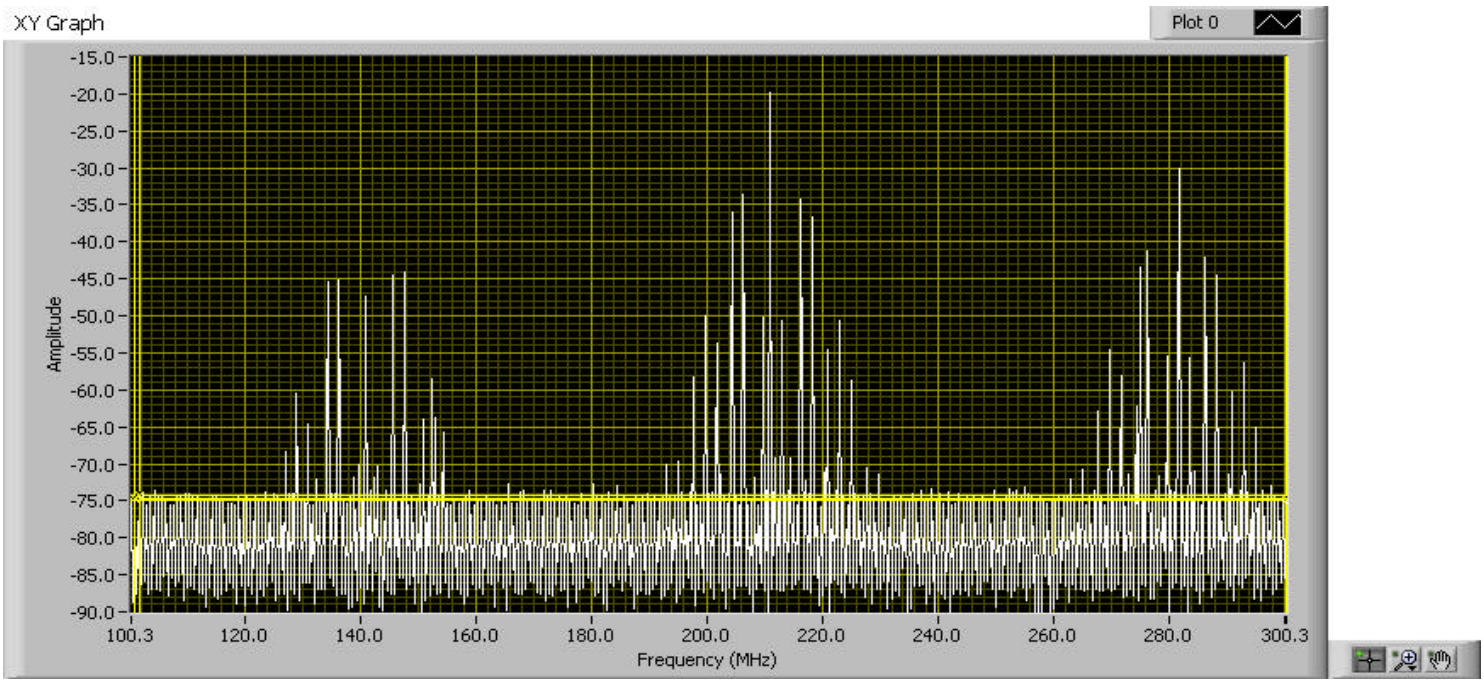


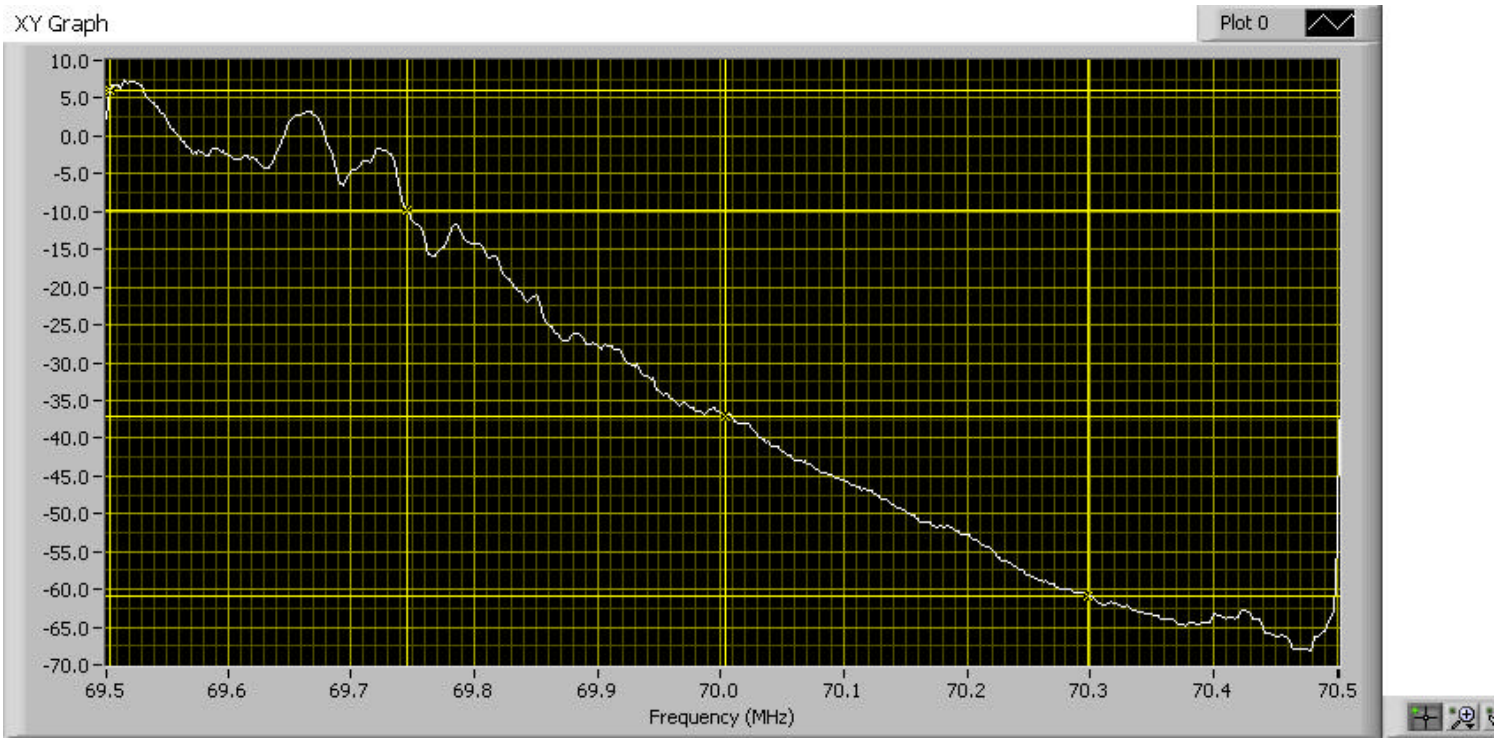
100 TO 300 AUDIOU S OFF



100 TO 300MHz AUDIOS ON



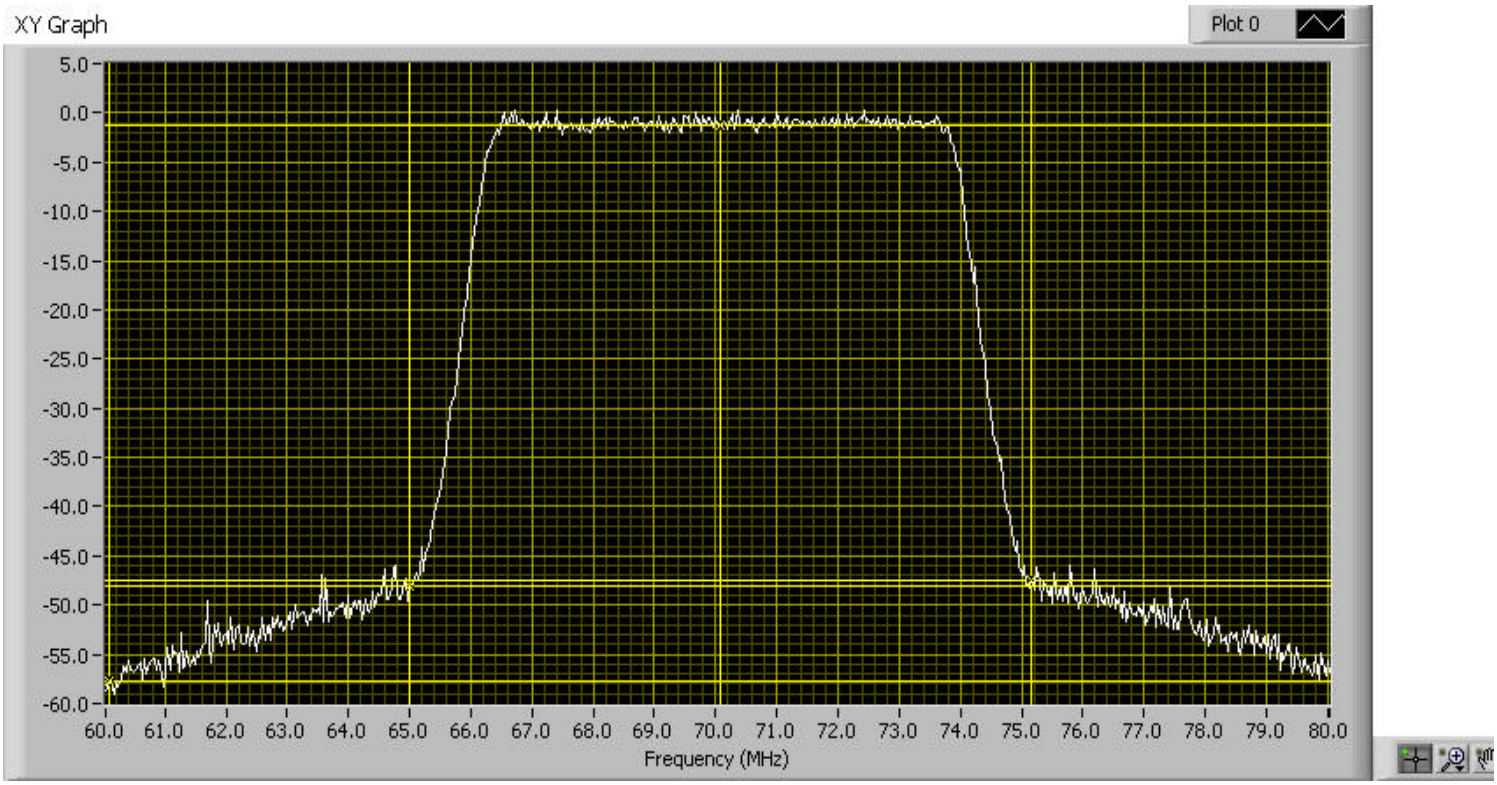
PHASE NOISE



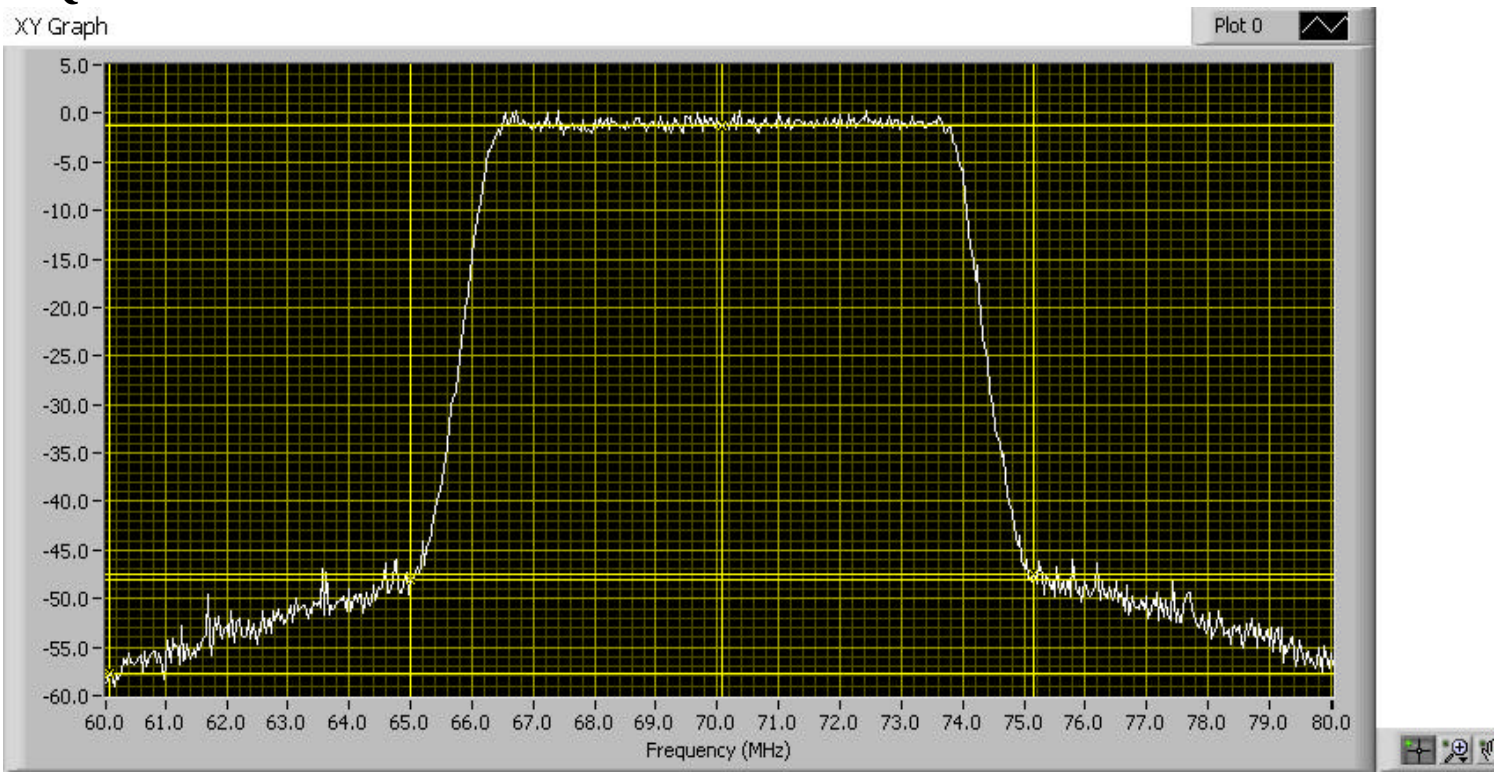
Spot frequencies removed from 70 MHz carrier 1Khz = -71dbc
10Khz = -96 dbc 100khz = 117.8 dbc/Hz

70Mhz digital COFDM IF output plots
QPSK

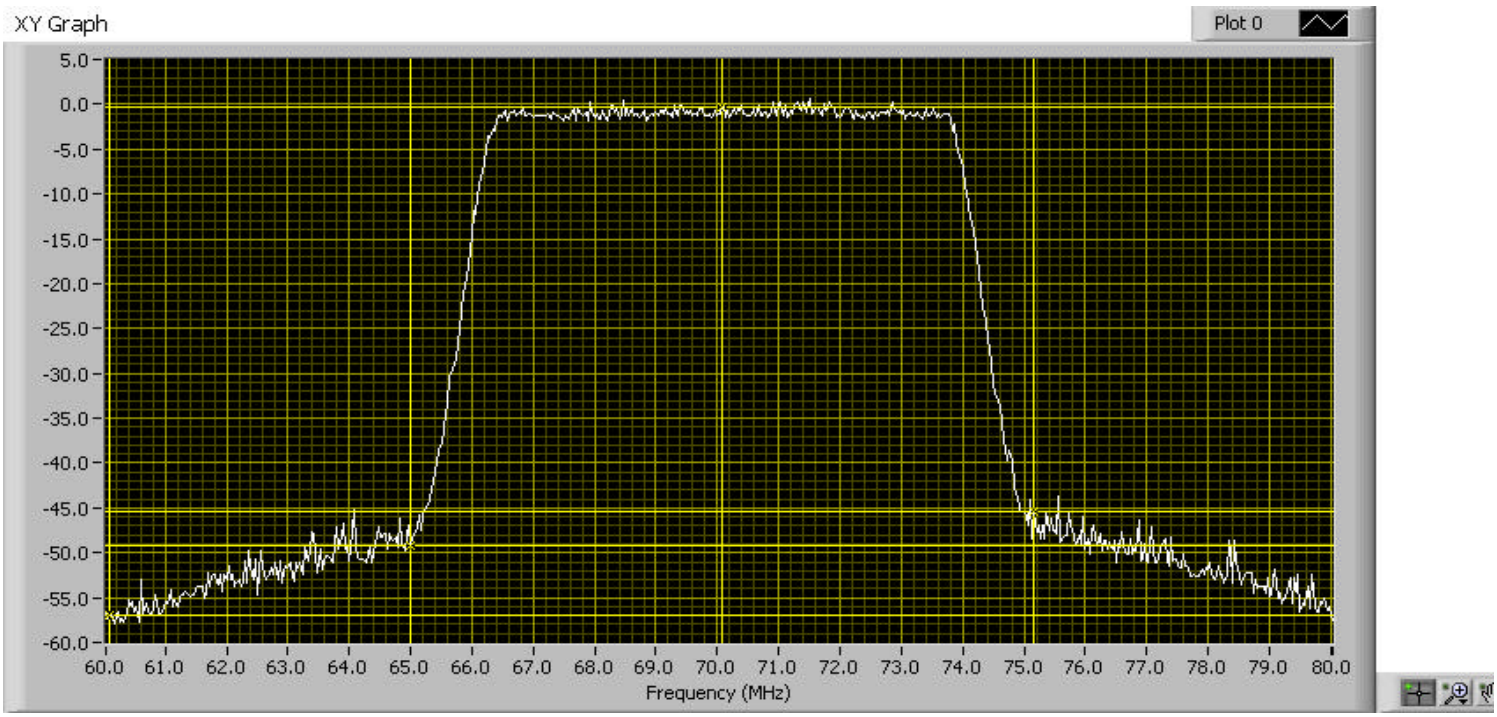
1



16QAM



64QAM



The modulation profile is 1/2 FEC 8Mhz bandwidth QPSK, 16QAM, and 64QAM

NOTE:

The preceding spectral plots are the intermediate frequency output of the system controller witch constitutes ancillary equipment and as such little note is made of its spurious output as it is suppressed at the RFU input

The following spectral plots represent the transmitter output at the antenna port And are subject to the limits and specifications as detailed for class B equipment under 47 CFR 74.637A

1

SPECTRAL MASK,S PART 74 CODE RUNNER CR2 ODU

FCC Rules:

Currently, FCC rules part 74.637 (a) (2) governs the emission bandwidth requirements for Broadcast Auxiliary Services (BAS) operations using transmissions employing digital modulation techniques.

The rule states the following:

“For operating frequencies below 15 GHz, in any 4 KHz reference bandwidth (Bref), the center frequency of which is removed from the assigned frequency by more than 50 % up to and including 250 % of the authorized bandwidth: As specified by the following equation but in no event less than 50 decibels:

$A = 35 + 0.8 (G – 50) + 10 \log B$

(Attenuation greater than 80 decibels is not required)

Where:

A = attenuation (in decibels) below the mean output power level.

G = Percent removed from the carrier frequency.

B = “Authorized bandwidth in megahertz”

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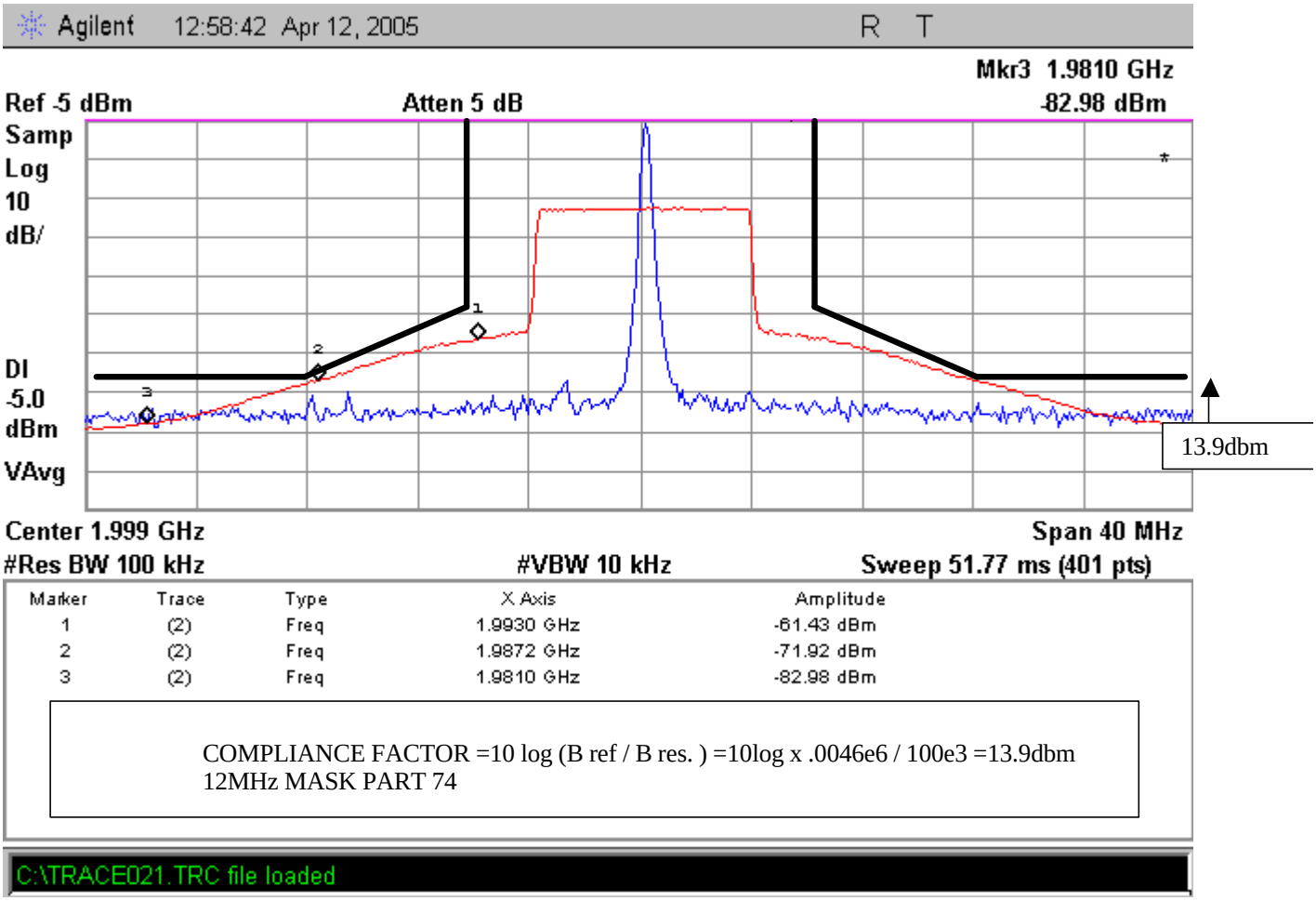
12 & 17 MHz SPECTRAL MASK PLOTS

PLOT # 1

COFDM QPSK 8MHz BW I/2 FEC 5 WATTS 37dbm

COMPLIANCE FACTOR =10 log (B ref / B res.) =10log x .0046e6 / 100e3 =13.9dbm

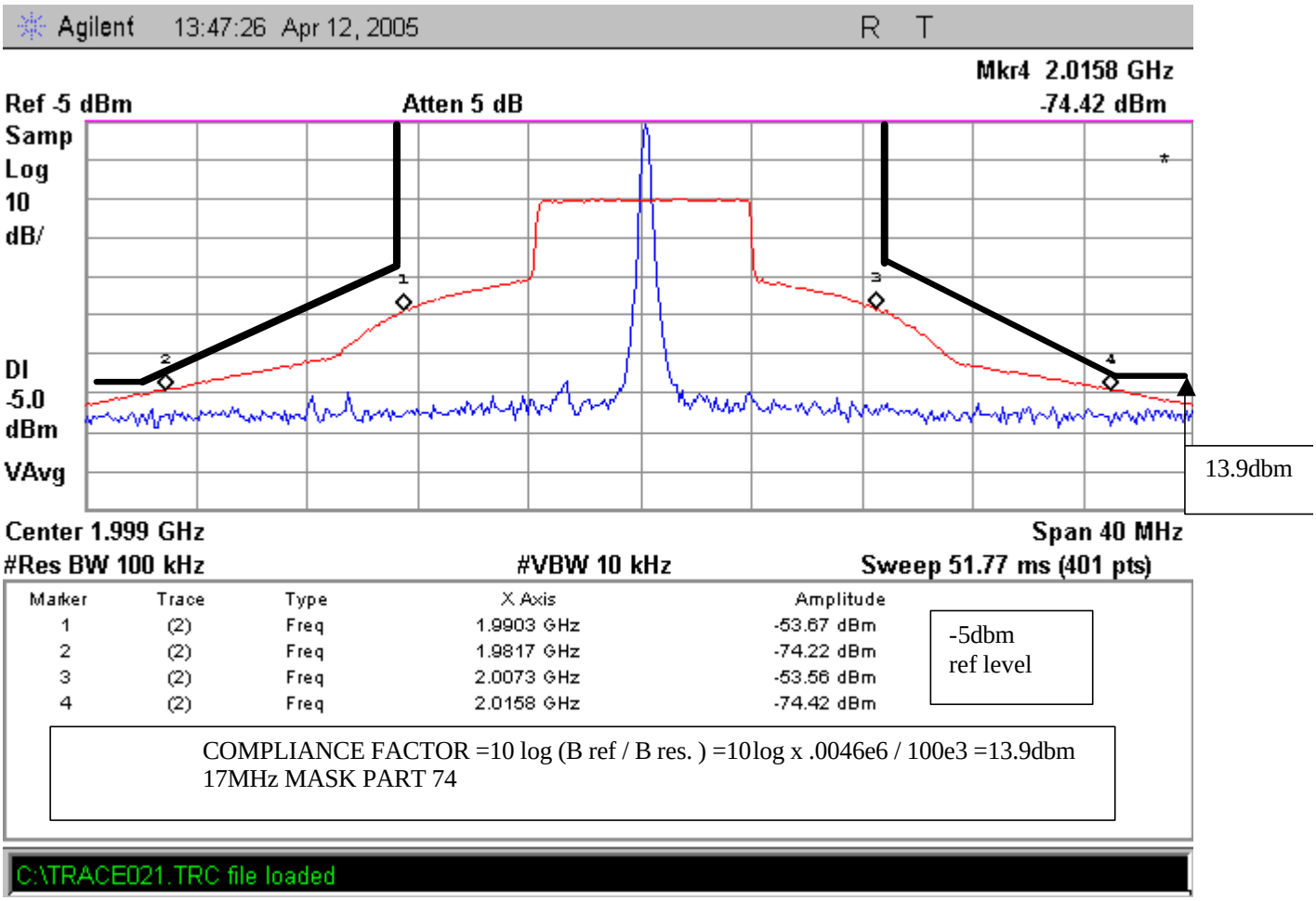
12MHz MASK PART 74



MASK CALCULATED 33dbm + .08(G-50) log 12 = 50dbm (per rule) - The Compliance factor 10log (B ref./B res.)= 13.9dbm The 100 % BW LIMIT = - 66dbm

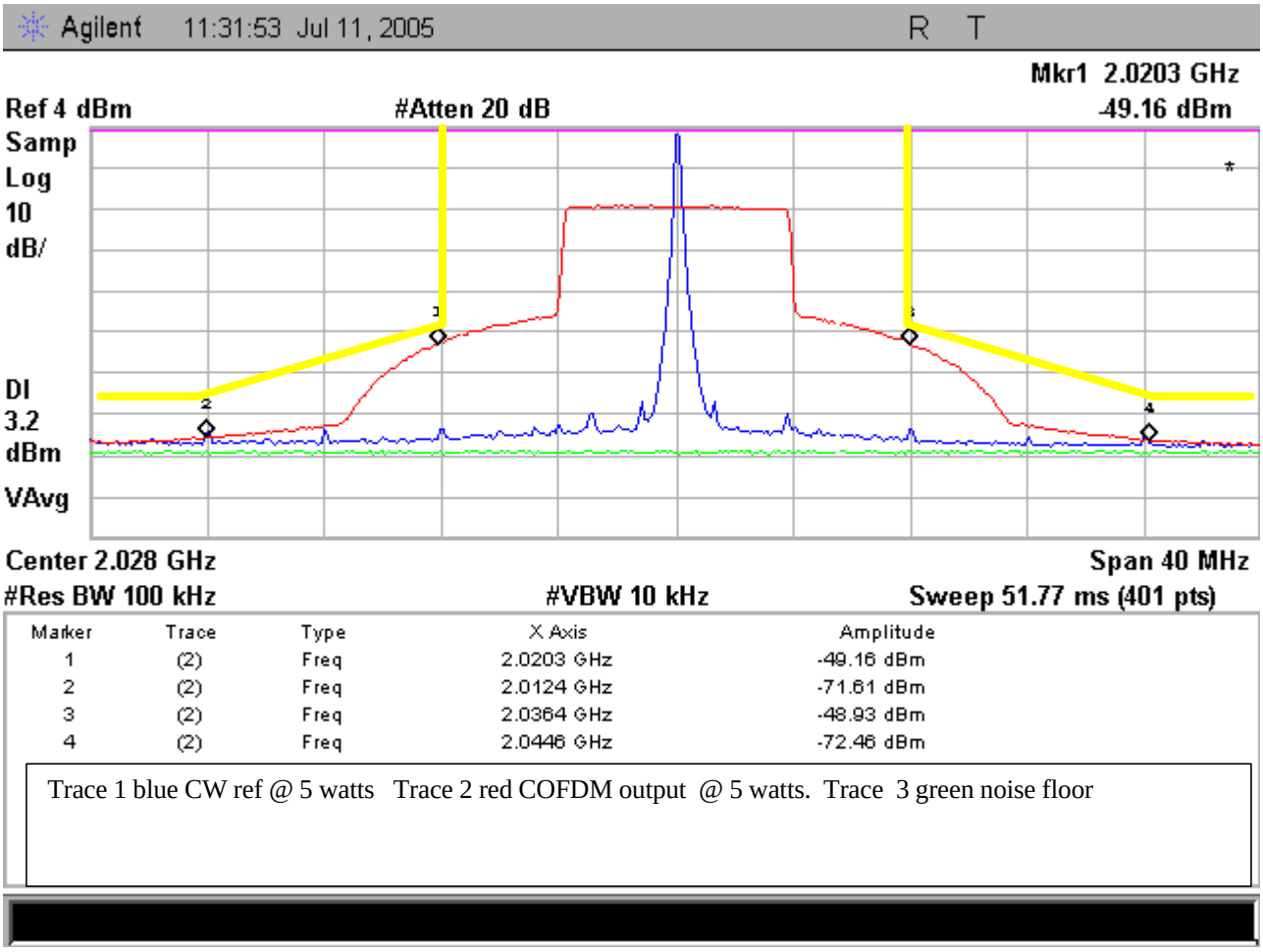
1

Plot# 2
17MHz mask COFDM QPSK 8MHz BW ½ FEC 36.5 DBM OUT @ 4.4 WATTS



MASK CALCULATED 33dbm + .08(G-50) log 17 = 50dbm (per rule) + The Compliance factor 10log (B ref./B res.)= 13.9dbm
The 100 % BW LIMIT =- 66dbm

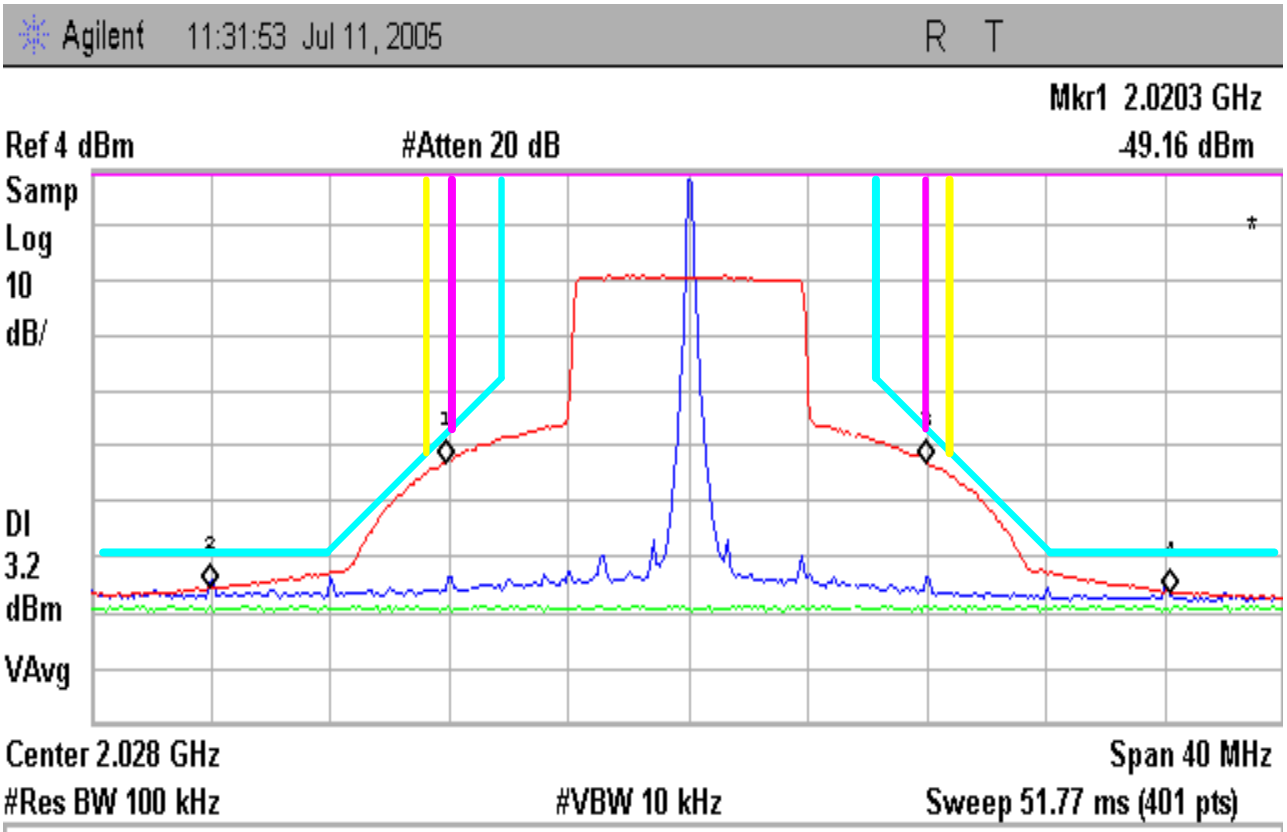
PLOT #3
SPECTRAL PLOT 16 MHz MASK
COFDM QPSK 8MHz BW ½ FEC 37 DBM OUT @ 5 WATTS



MASK CALCULATED 33dbm + .08(G-50) log 17 = 50dbm (per rule) + The Compliance factor 10log (B ref./B res.)= 13.9dbm
The 100 % BW LIMIT =- 66dbm

1

16 QAM COFDM 8MHz ½ FEC @ 5 WATTS 12,16, 17 MHZ MASKS



17MHz

16MHz

12MHz

Marker	Trace	Type	X Axis	Amplitude
1	(2)	Freq	2.0203 GHz	-49.16 dBm
2	(2)	Freq	2.0124 GHz	-71.61 dBm
3	(2)	Freq	2.0364 GHz	-48.93 dBm
4	(2)	Freq	2.0446 GHz	-72.46 dBm

MASK CALCULATED 33dbm + .08(G-50) log 17 = 50dbm (per rule) + The Compliance factor 10log (B ref./B res.)= 13.9dbm
The 100 % BW LIMIT =- 66dbm

OCCUPIED BANDWIDTH 8 AND 6MHz QPSK